Remarks

The following comments are provided in support of the claims presented. Applicants respectfully request reconsideration of the claims and entry of the amendments presented herein.

**1. § 103 Rejections**

**A.** Claims 1 and 5-9 have been rejected under 35 USC §103(a) as being obvious over Lin et al (US 6,123,865) in view of Cripe et al (US 5,851,928).

Applicants have herein amended Claim 1 to recite that the etching is performed "by immersing the semiconductor device into an etching solution comprising hydrofluoric acid (HF) and sulfuric acid ($H_2SO_4$)." Support for this amendment to Claim 1 can be found on page 8, lines 9-20 and on page 9, lines 20-24.

Applicants respectfully submit that the amendment presented herein to Claim 1 overcomes the § 103 rejection of Claims 1 and 5-9 since neither Lin et al or Cripe et al teach or suggest the use of immersion etching, but instead teach against immersion etching as discussed below.

Lin et al teaches against immersion etching in favor of spray etching while the substrate is being rotated in order for the cited advantages of obtaining better etch uniformity, increasing the etching speed and using less chemicals. This can be seen on page 1, lines 31-42 of Lin et al which is cited below:

> Two basic etching techniques are immersion etching and spray etching. Immersion etching is the simplest technique. The masked or unmasked wafer is submerged in the etch solution, and mechanical agitation is usually required to ensure etch uniformity and a consistent etch rate. Spray etching offers several advantages over immersion etching. Spray etching requires less volume of chemicals and is faster than immersion etching. Good process control and etch uniformity are easily obtained from spray etching because fresh etchant is constantly supplied to the wafer surface while the etch products are continuously removed. Single wafer spinning-chuck spray systems offer considerable process uniformity advantages.

Lin et al also requires a step for "forming a water film over the wafer surface prior to etching" which "helps the subsequent viscous etchant to be spread across the wafer surface more uniformly to thereby improve the etch uniformity" (see col. 2, lines 5-11 and claim 1). Forming such a thin water film necessitates spinning the wafer prior to contacting a surface of the spinning wafer with the etchant to remove excess water which could otherwise damage the semiconductor device (see col. 2, lines 18-29).

Cripe et al also teach that the etching is performed on a spinning wafer without immersion. Cripe et al teaches against the use of conventional etch processes including immersion etching as being time consuming, as resulting in undercutting and wastage, and thereby not being cost efficient. This can be found in col. 1, lines 38-49 which states:

> However, the conventional dry and wet etchants used to etch semiconductor substrates produce many other problems when applied to die singulation. For example, due to the thickness of a conventional semiconductor substrate, conventional etch processes are very time consuming when used to singulate semiconductor dice. Additionally, when etching large depths into a semiconductor substrate, conventional etch processes produce large quantities of undercut in the semiconductor substrate. Consequently, conventional etch processes are not cost efficient because of the large portions of the semiconductor substrate that are undercut and wasted.

Rather than immersion etching, Cripe et al dispense the etchant onto a rotating substrate using a flow nozzle in order "to produce a more uniform etch" (see col. 4, lines 15-28).

Applicants respectfully submit that the above teaching against the use of immersion etching in both Lin et al and Cripe et al provides evidence for the *prima facie* unobviousness of Claims 1 and 5-9 based on this combination set forth by the Office. Furthermore, Lin et al and Cripe et al would not motivate one skilled in the art to perform the etching by immersion as recited in Applicants' amended Claim 1, but to the contrary would lead that person to perform the etching with a rotating substrate and with the etchant dispensed over the rotating substrate as a spray or str am of etchant. These modes of etching, as taught by Lin et al and Cripe et al,

which require the substrate to be rotated at high speed and the etchant to be dispensed only on one side of the substrate, are contrary to immersion etching as recited in amended Claim 1 wherein the semiconductor device is immersed into an etching solution. Therefore, Applicants urge that, with the amendment presented herein to Claim 1, Claims 1 and 5-9 are allowable.

B. Claims 2-4 have been rejected under 35 USC § 103(a) as being unpatentable over Lin et al and Cripe et al in view of Gennissen (Sacrificial Oxide Etching Compatible with Aluminum Metallization, Proceedings of the 1997 International Conference on Solid-State Sensors and Actuators, Transducers '97, pp. 225-228, 1997).

As amended herein, Claim 1 is unobvious over the combination of Lin et al and Cripe et al which both teach away from the recited step of "immersing the semiconductor device into an etching solution" in amended Claim 1. Therefore, Claims 2-4, which stem from allowable Claim 1 and add further limitations thereto, must be allowable over the combination of Lin et al, Cripe et al and Gennissen.

Applicants further submit that one skilled in the art would not be motivated to combine Lin et al and Cripe et al with Gennissen for the following reasons:

1. Gennissen requires etching by immersion (see last sentence on left hand column on page 227: "After the 6 min etch the samples were taken out of the etch mixture and rinsed in IPA..."); whereas both Lin et al and Cripe et al teach against immersion etching as described above. Thus, one skilled in the art would not be motivated to combine Gennissen with Lin et al and Cripe et al due to the contrary modes of etching which are not compatible.
2. Gennissen teaches against any etching of aluminum by providing an etching solution "to selectively etch the sacrificial oxide without attacking the aluminum" (see first sentence in Summary on page 225 and second sentence in Introduction on page 225). This is contrary to Lin et al who disclose an etching solution that etches aluminum (see col. 2, lines 36-37 and claims 3 and 12). Thus, one skilled in the art would not be motivated to combine Gennissen, who teaches against

etching aluminum, with Lin et al who teaches the etching of aluminum since the result would be a nullity.

3. Gennissen teaches against the use of water as a part of the etching process. This is stated in the first paragraph on right-side column on page 227: "Rinsing in water is not possible as this would lead to rapid attack of the aluminum." Gennissen further states in the last sentence in the Conclusions in Gennissen on page 228: "The samples should not be rinsed in water, since water addition to the HF will result in rapid attack of the aluminum interconnect due to a higher $H_3O^+$ concentration." These statements by Gennissen against the use of water for contacting the substrate and an aluminum metallization thereon are contrary to Lin et al who require a thin film of water to be disposed over the substrate and any layers thereon including an aluminum metallization layer since this "helps the subsequent viscous etchant to be spread across the wafer surface more uniformly to thereby improve the etch uniformity" (see col. 2, lines 5-11, and independent claims 1 and 7). Applicants urge that these contrary requirements with respect to contacting the substrate and any aluminum layer thereon with water would result in a nullity so that one skilled in the art would not be motivated to combine Gennissen with Lin et al and Cripe et al.

Applicants respectfully submit that the contrary teachings of Gennissen as compared with Lin et al and Cripe et al as cited above provides evidence for the *prima facie* unobviousness of this combination set forth by the Office. Therefore, Applicants respectfully submit that the Office has not made a valid *prima facie* case of obviousness for the rejection of Claims 2-4 so that Claims 2-4 must be allowable.

## Conclusion

Applicants have responded to each and every rejection and objection, and urge that the Application is in condition for allowance. A favorable reconsideration and entry of the amendments presented herein is earnestly solicited as being necessary to place the application in condition for allowance or appeal.

Respectfully submitted,

Dated: July 16, 2003

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I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being sent by Facsimile on the date shown below to the PTO by Fax at (703) 872-9311.

John P. Hohimer
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Dated: July 16, 2003

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